Basement Insulation

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Basement Insulation

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Introduction

If you own a home with an uninsulated basement, you are paying up to 30 per cent more to heat your home than the same home with an insulated basement. **Earth around the basement is not a good insulator, and the concrete itself conducts heat out of the house.** Cracks and holes in your foundation wall and the rim joist area allow warm air to leak out of your house (Figure 1). This could mean $150 or more lost each year through unnecessary heating costs. Compare to this the approximate cost of $600 for framing and insulating materials to insulate a basement on the inside, or $1 200 for materials to insulate outside the foundation of a 110 square metres (1 200 square feet) bungalow.

An insulated basement also adds to the livable area of your home, and will make it more comfortable and evenly heated.

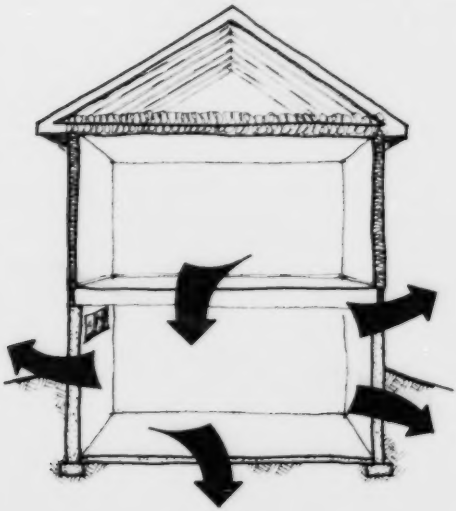


Figure 1

Two Methods of Insulating

You can insulate basement walls either inside or outside the foundation. The following table compares the advantages and disadvantages of the two methods.

Insulation Method

	Advantages	Disadvantages
Interior	• results in smooth wall for easy decorating • work can be done in any weather • space provided for wiring and plumbing • easy installation of air/vapour barrier • landscape is undisturbed • increases living space • can be done in stages to accommodate budget	• interior finishing may already be completed • difficult if ducts and pipes are against wall • water lines must be inside the insulated wall to avoid freezing • difficult to seal air/vapour barrier in floor joist area
Exterior	• no disturbance of previous interior work • interior water lines are protected • no loss of living space • even temperature reduces thermal stress on concrete • any cracks or leaks can be repaired • some rigid insulating materials will act as an additional moisture barrier • basement wall can act as a thermal mass, storing heat in the house • most effective way to insulate the joist area	• requires extensive digging • difficult to do near patios, steps, decks • disturbs existing landscaping • excavation work is physically demanding • insulation can be damaged by shifting or settling • must be completed quickly in case of flooding • must be completed in warm weather • uses more expensive materials

Review the pros and cons and decide on the better solution for you. This publication will describe in detail the most common method, insulating from the interior. Information is also presented on exterior insulation, but for more detail you should contact the manufacturer or local distributors of exterior insulations.

Before you Start

Familiarize yourself with the basic parts of a foundation wall (Figure 2). The drawing shows a construction where the floor joists are embedded in the concrete foundation. Another common technique is referred to as platform framing, in which the floor joists sit on top of a wood plate that in turn rests on the concrete foundation wall.

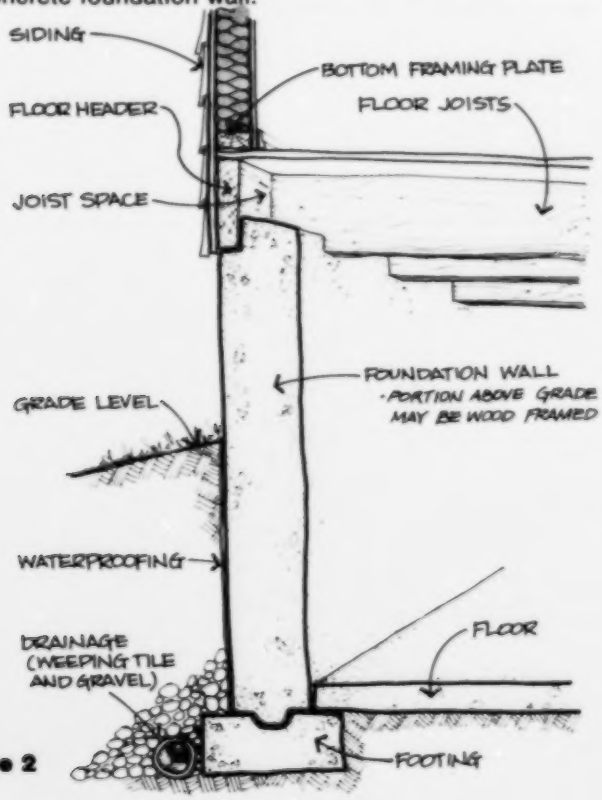


Figure 2

Upgrading the insulation and wall finishes in your home is an "improvement". Check with your local building inspector to obtain any necessary building or development permits.

The Alberta Building Code requires a minimum RSI value of 1.4 (R 8) from the top of the basement walls down to 600 mm (24 inches) below ground level in new homes. We recommend an RSI value of 2.1 to 3.5 (R 12 to R 20) down the complete wall for greater energy savings and comfort.

Check for water problems before insulating. Minor moisture problems can often be repaired on the inside of the foundation wall with sealant or epoxy waterproofing compounds. These are available at building supply outlets. Serious water leakage requires repair from the outside.

Interior Basement Insulation

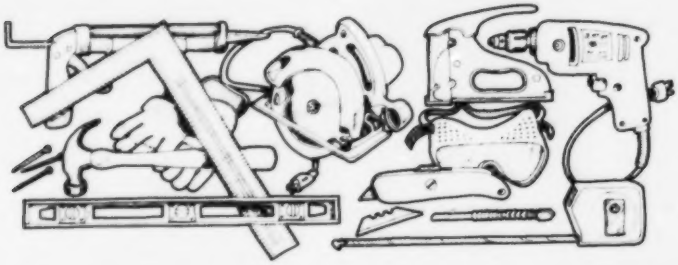
For interior insulating, if your basement has had no work done on it in the past, starting the job will be easy. Chances are some wall finishing work has been done. If there is no proper air/vapour barrier and little or no insulation, it is best to remove the finishes. This will also allow you to check for moisture damage and adequately seal and insulate the joist space.

Two Methods of Insulating the Interior

1. The most common method uses wall framing filled with glass fibre batts. This method is described in detail in this booklet.

2. The second method involves fastening rigid board insulation to the wall. A number of fastening systems can be used in addition to standard framing. Check with the local distributor or manufacturer of the rigid insulation material for their recommended method of application. **Note that the Alberta Building Code requires extruded and expanded polystyrene to be covered with a fireproof layer of drywall or plaster.**

Tools for the Job



- basic carpentry tools
- sharp knife for cutting insulation batts, rigid insulation sheets, polyethylene air/vapour barriers, caulking and moisture barriers
- caulking gun, stapler
- drill, masonry bit and masonry nails
- safety and protection equipment such as a hard hat, goggles, gloves and a breathing mask should be used when working with power tools and installing some insulation materials

Sealing the Walls

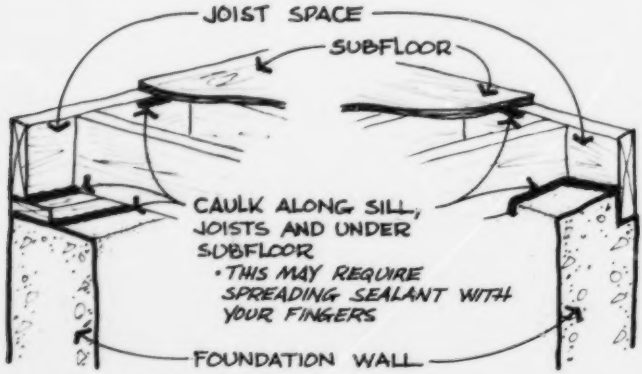

JOIST SPACE
SUBFLOOR
CAULK ALONG SILL, JOISTS AND UNDER SUBFLOOR
• THIS MAY REQUIRE SPREADING SEALANT WITH YOUR FINGERS
FOUNDATION WALL

Figure 3

It is easiest to seal the wall and joist space against air leakage before you start framing or applying rigid insulation. Figure 3 shows where to caulk in the sill-plate and joist area. Be sure to seal around any service pipes, ducts or conduits that go through the walls or end joists. Fill larger gaps with a foam backing rod or polyurethane spray foam. This will act as a backing for caulking (Figure 4).

Polyurethane foam can be used as an alternative to caulking as it will both seal and insulate larger gaps. **It must be covered with 13 mm (½ inch) drywall or equivalent for fire protection if exposed to the inside of the home.**

Use a good quality, durable caulking material that is compatible with concrete. Another publication in this series, **Caulking and Weatherstripping**, contains more information on types of caulking materials and methods of application.

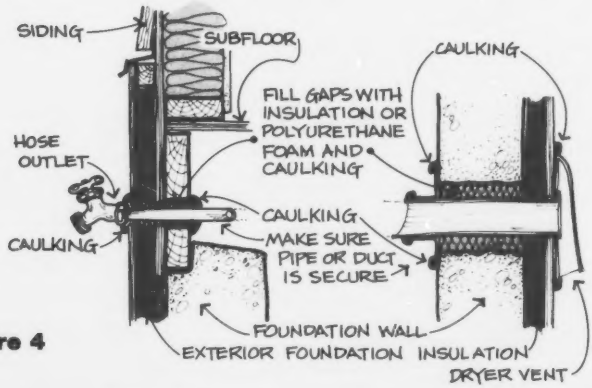


Figure 4

Moisture Barrier

A moisture barrier is required to protect the insulation and framing materials from water damage. The moisture barrier (this is not an air/vapour barrier) must extend from ground or grade level down to the basement floor and under the bottom plate. **It is important that this barrier only extend up to the grade line to prevent trapping any moisture within the wall structure** (Figure 5).

The moisture barrier is usually polyethylene, or a waterproof coating.

The polyethylene is attached to the wall with an adhesive, wooden batten or stapled to the outside of the wall framing before the frame is placed in sections against the foundation wall. If a waterproof coating is used, it is painted or sprayed on the basement wall before construction. In both cases, the bottom plate of the basement framing should be protected from the concrete with a strip of polyethylene (Figure 6).

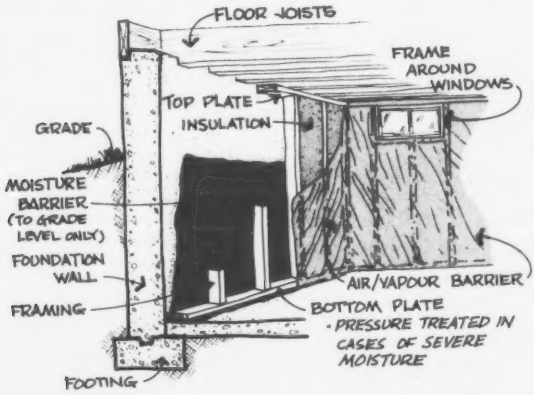


Figure 5

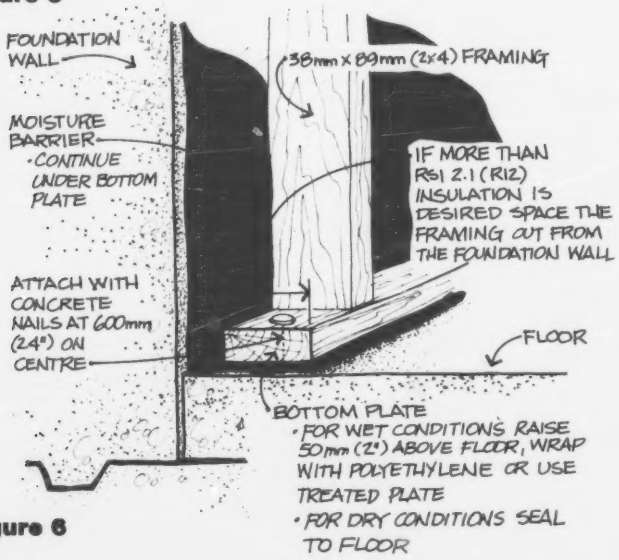

FOUNDATION WALL
38mm x 89mm (2x4) FRAMING
MOISTURE BARRIER
• CONTINUE UNDER BOTTOM PLATE
IF MORE THAN RSI 2.1 (R12) INSULATION IS DESIRED SPACE THE FRAMING OUT FROM THE FOUNDATION WALL
ATTACH WITH CONCRETE NAILS AT 600mm (24") ON CENTRE
FLOOR
BOTTOM PLATE
• FOR WET CONDITIONS RAISE 50mm (2") ABOVE FLOOR, WRAP WITH POLYETHYLENE OR USE TREATED PLATE
• FOR DRY CONDITIONS SEAL TO FLOOR

Figure 6

Wall Framing

Use wall framing of 2x4's at 400 mm (16 inches) or 600 mm (24 inches) on centre to provide an insulation cavity, wiring space and support for the interior finish. The interior face can be placed 90 mm (3½ inches) in from the foundation wall for RSI 2.1 (R 12) batt insulation or 140 mm (5½ inches) for RSI 3.5 (R 20) batt insulation. Use a single top and bottom plate and single members around windows. There are many references available showing framing techniques. One is **Canadian Wood Frame House Construction**, available from Canada Mortgage and Housing Corporation (CMHC). If the foundation wall and floor are always dry, seal the bottom plate to the floor. Use caulking or a gasket material to prevent warm air from leaking under and up the foundation wall behind the insulation.

Bilevel homes are a special case. Two techniques for framing inside a bilevel are shown in Figure 7.

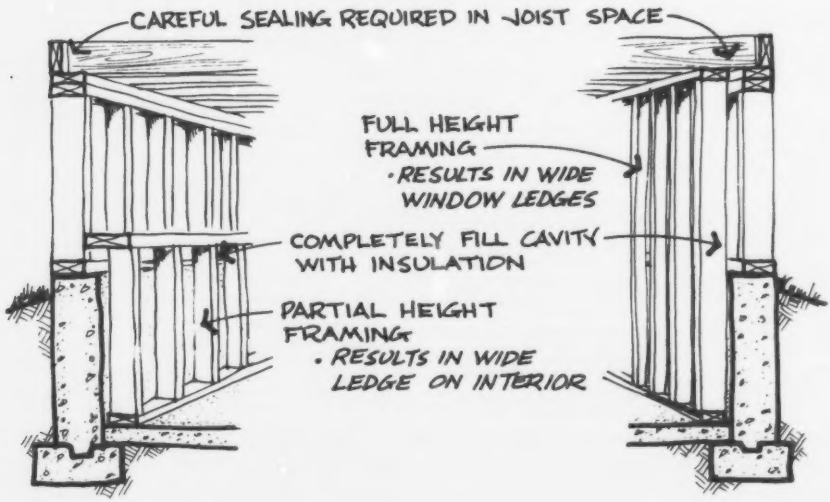

CAREFUL SEALING REQUIRED IN JOIST SPACE
FULL HEIGHT FRAMING
• RESULTS IN WIDE WINDOW LEDGES
COMPLETELY FILL CAVITY WITH INSULATION
PARTIAL HEIGHT FRAMING
• RESULTS IN WIDE LEDGE ON INTERIOR

Figure 7

Framing around stair wells and landings may also pose problems. A cold storage room will not require framing on the outside walls but should be sealed off from the rest of the basement. Each situation is unique and you may have to improvise. **Always place the air/vapour barrier on the warm side of the insulation.**

If possible, place the framing behind any pipes or ducts located close to the foundation walls to prevent freezing (Figure 8). **Be sure not to leave any pipes or drains on the outside of the insulation layer.** Many plumbing reference books outline simple drainage and water line renovations, if moving them is necessary.

Electrical panels or gas and water meters may pose particular problems. Moving them requires qualified personnel and may be expensive. The simplest solution is often to just insulate and frame as closely as possible to the unit. Thinner rigid insulation pieces may be used behind pipes or lines.

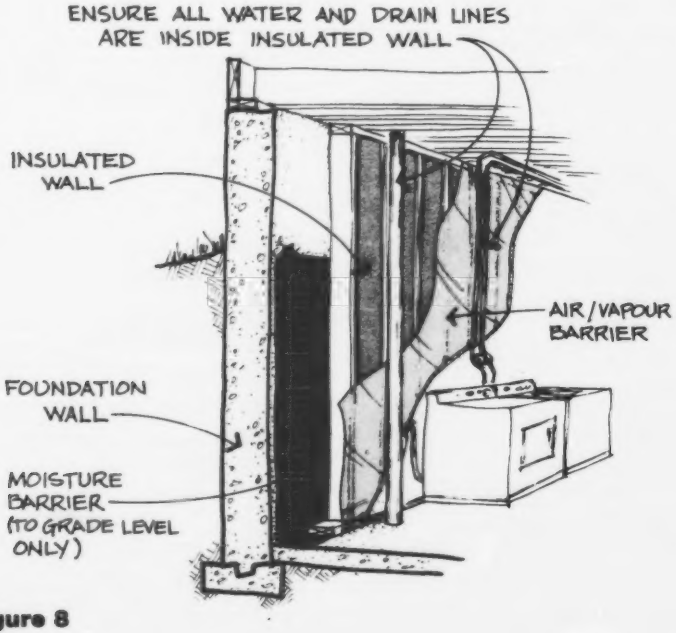

ENSURE ALL WATER AND DRAIN LINES ARE INSIDE INSULATED WALL
INSULATED WALL
AIR/VAPOUR BARRIER
FOUNDATION WALL
MOISTURE BARRIER (TO GRADE LEVEL ONLY)

Figure 8

Be careful near electrical panels since they are still "live" even when the main switch is off.

Electrical work can be done by a qualified electrician or the capable homeowner as reference books are available to aid in wiring design and layout. Be sure to obtain the necessary permits and inspections.

Switch, outlet and junction boxes on outside walls should have an air/vapour barrier installed behind them. It can be one of the commercially available polyethylene types or be constructed of a square piece of polyethylene forming a "bag" around each of the boxes.

Before proceeding, check once again to make sure any holes in the joist spaces or walls have been caulked to prevent air leakage.

Wall Insulation

Batt insulation is usually used because it is relatively inexpensive and easy to install in stud spaces. The stud spaces must be completely filled to prevent heat loss caused by air movement behind the insulation. Make sure you cut the insulation pieces to exact sizes required. Do not fold or overlap any pieces to make them fit.

Be sure to fill the joist space cavity as well. Figure 9 shows different joist space configurations and suggestions for insulating and sealing that area. Note that in wall type "C", an air space is required above the insulation to avoid a cold floor perimeter.

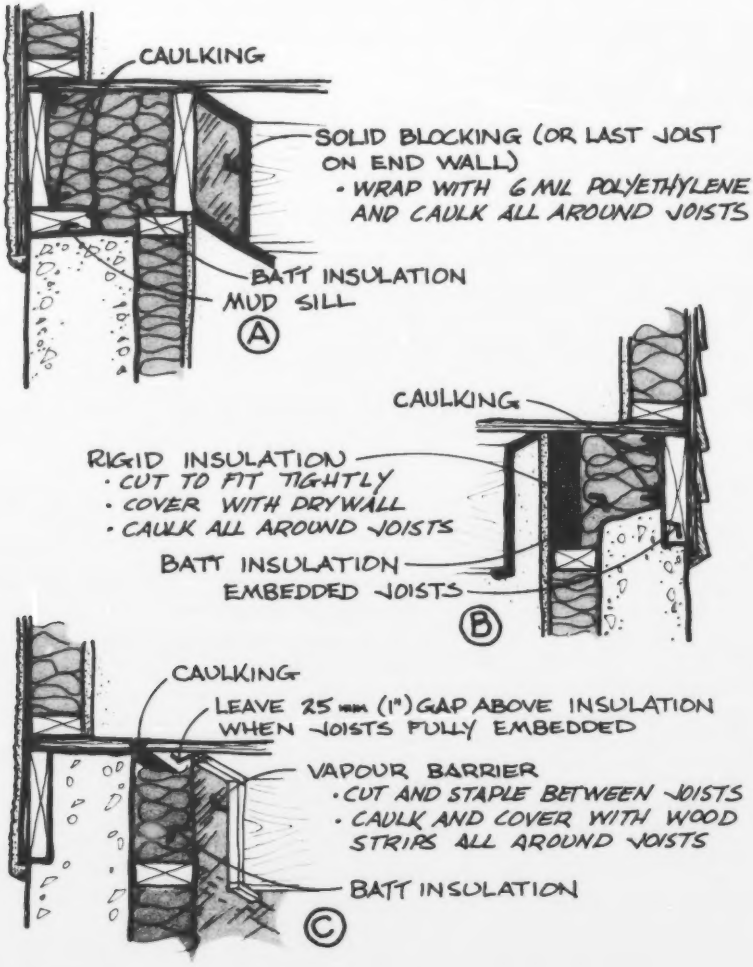

CAULKING
SOLID BLOCKING (OR LAST JOIST ON END WALL)
• WRAP WITH 6 MIL POLYETHYLENE AND CAULK ALL AROUND JOISTS
BATT INSULATION
MUD SILL
A
CAULKING
RIGID INSULATION
• CUT TO FIT TIGHTLY
• COVER WITH DRYWALL
• CAULK ALL AROUND JOISTS
BATT INSULATION
EMBEDDED JOISTS
B
CAULKING
LEAVE 25 mm (1") GAP ABOVE INSULATION WHEN JOISTS FULLY EMBEDDED
VAPOUR BARRIER
• CUT AND STAPLE BETWEEN JOISTS
• CAULK AND COVER WITH WOOD STRIPS ALL AROUND JOISTS
BATT INSULATION
C

Figure 9

Insulate the walls between a cold storage room and the heated basement. The ceiling of a cold storage room must also be insulated. If there are floor overhangs in your home, as in many bilevels, or under bay or bow windows, seal well and insulate as shown in Figure 10.

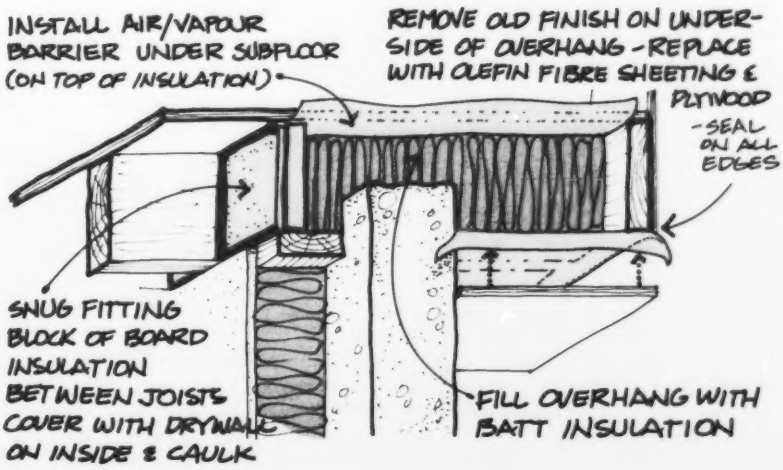

INSTALL AIR/VAPOUR BARRIER UNDER SUBFLOOR (ON TOP OF INSULATION)
REMOVE OLD FINISH ON UNDER-SIDE OF OVERHANG - REPLACE WITH OLEFIN FIBRE SHEETING & PLYWOOD - SEAL ON ALL EDGES
SNUG FITTING BLOCK OF BOARD INSULATION BETWEEN JOISTS COVER WITH DRYWALL ON INSIDE & CAULK
FILL OVERHANG WITH BATT INSULATION

Figure 10

Before proceeding, survey the wall insulation to make sure all areas have been filled. Check that the joist space has been insulated properly. **Make sure no pipes or ducts are on the cold side of the insulation.**

Air/Vapour Barrier

An air/vapour barrier is essential on the inner, or warm, surface of an exterior wall. This barrier can be provided by 0.10 mm or 0.15 mm (4 mil or 6 mil) polyethylene. Staple the polyethylene to the framing, using only enough staples to hold the material in place. Don't pull tight.

All joins should overlap one joist or stud space (Figure 11). Caulk all edges and overlap with a non-skinning acoustical sealant. Overlaps, joins or edges can be reinforced with a strong tape before stapling.

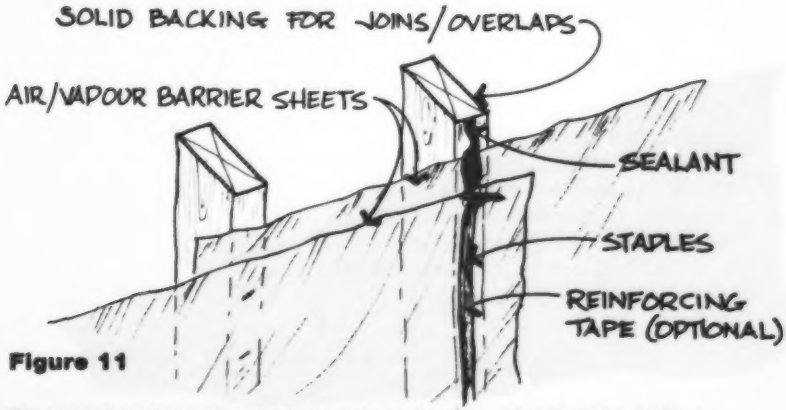


Figure 11

Electrical outlets should be enclosed with polyethylene before installation. A commercial polyethylene box can be purchased or made up of loose polyethylene. Seal the edges of this box to the wall air/vapour barrier. The barrier should also be sealed around window and exterior door openings (Figure 12) and in the joist space by one of the methods shown in Figure 9.

For more information on sealing and weatherstripping windows and doors, see the publication **Caulking and Weatherstripping** in this series.

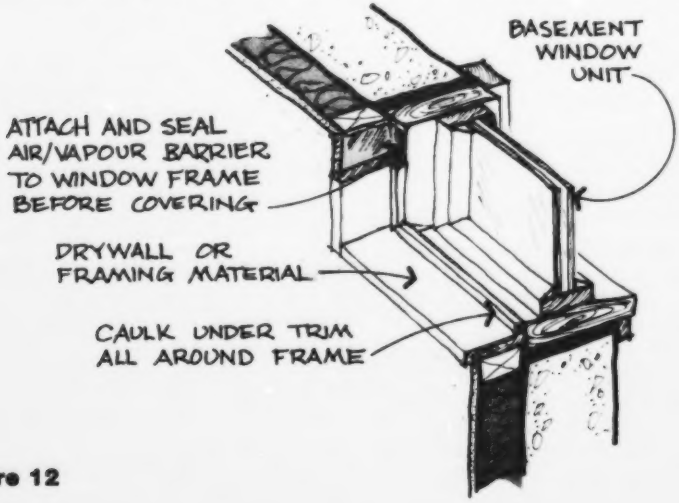

BASEMENT WINDOW UNIT
ATTACH AND SEAL AIR/VAPOUR BARRIER TO WINDOW FRAME BEFORE COVERING
DRYWALL OR FRAMING MATERIAL
CAULK UNDER TRIM ALL AROUND FRAME

Figure 12

A new and experimental method, called the Airtight Drywall Approach (A.D.A.), uses properly installed and treated drywall as the air/vapour barrier. To install a drywall air/vapour barrier, place a strip of gasket material along the bottom and side of the bottom plate (Figure 13). Current recommended gasket materials include closed-cell neoprene and vinyl-based glazing tapes and weatherstripping. Notch the drywall around the floor joists to provide a tight fit. Seal the drywall to the subfloor and the floor joists with caulking. Finally, tape the drywall and finish it with a vapour-barrier paint.

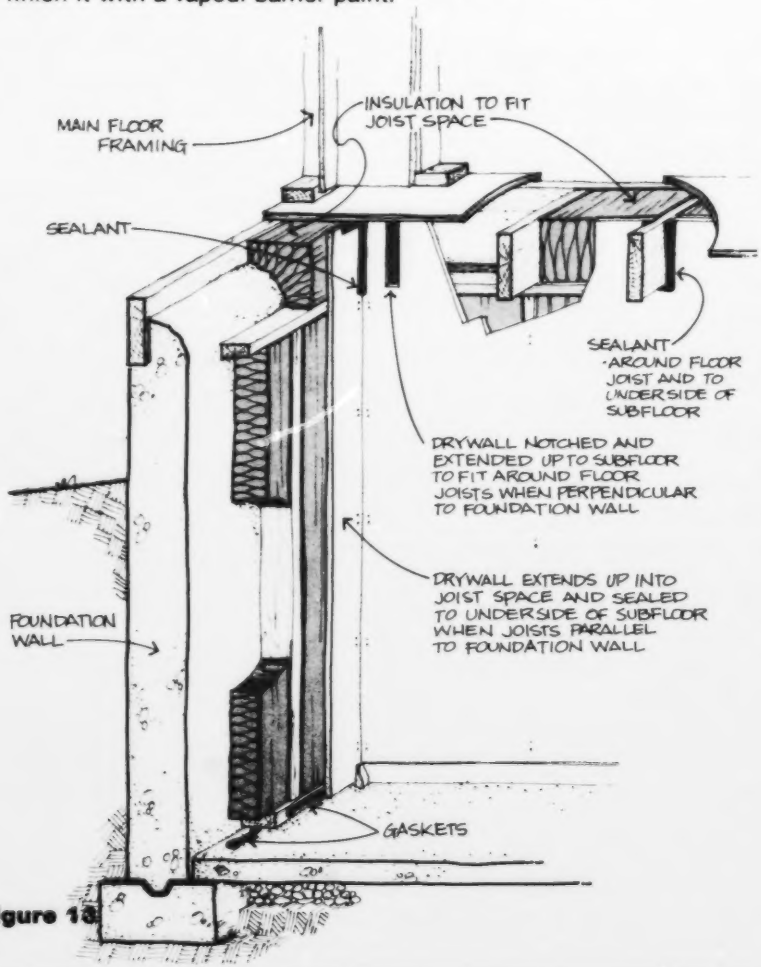

MAIN FLOOR FRAMING
INSULATION TO FIT JOIST SPACE
SEALANT
SEALANT AROUND FLOOR JOIST AND TO UNDERSIDE OF SUBFLOOR
DRYWALL NOTCHED AND EXTENDED UP TO SUBFLOOR TO FIT AROUND FLOOR JOISTS WHEN PERPENDICULAR TO FOUNDATION WALL
DRYWALL EXTENDS UP INTO JOIST SPACE AND SEALED TO UNDERSIDE OF SUBFLOOR WHEN JOISTS PARALLEL TO FOUNDATION WALL
FOUNDATION WALL
GASKETS

Figure 13

It is important to create as complete an air/vapour barrier as possible between inside and outside. Make sure you do not accidentally puncture the barrier. Repair any tears or holes in the polyethylene or drywall.

There are no limitations on wall or ceiling coverings unless expanded or extruded polystyrene or polyurethane insulations are used. **These products must be covered for fire protection with 13 mm (½ inch) drywall which is securely anchored to the structure.** Suspended ceiling systems are convenient for access if any repair work will be required on ducts or pipes.

Exterior Basement Insulation

Insulating a basement from the outside is less common because of the hard work, the mess and the high cost. However, for new homes or existing homes requiring major repair to the foundation wall, the exterior insulating method is practical.

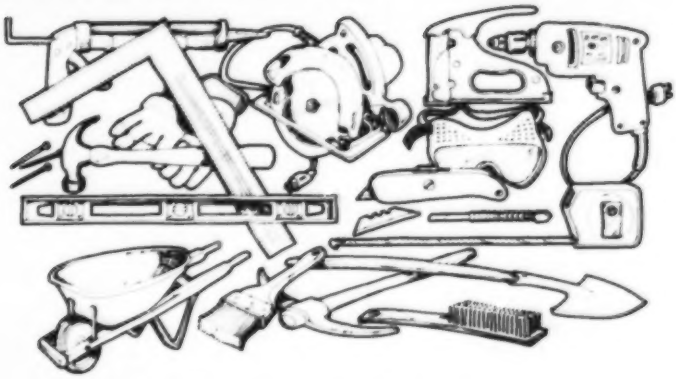
Exterior insulating involves digging around your foundation. You must mark the location and depth of utility services such as underground electrical services, gas piping, telephone and cable TV hook-ups. Local utility companies can provide this information.

Two Methods of Insulating the Exterior

1. For the first or **partial depth method**, place insulation against the wall down to 300 mm (12 inches) below ground. Then place insulation 900 to 1200 mm (36 to 48 inches) horizontally to control lower wall heat loss. Note that in new home construction, the Alberta Building Code requires vertical insulation down to 600 mm (24 inches) below ground level, either inside or outside the wall.

2. The second or **full depth method** requires placing the insulation vertically down the entire wall to the footings. This method is preferable as it is more effective in reducing heat loss. However, it is also much more difficult because a deeper trench is required.

Tools for the Job



- shovels, pick and wheelbarrow for the excavation
- scraper and stiff brush for cleaning the outside of the exposed foundation wall
- short bristle paint brush for applying waterproofing materials
- normal carpentry tools
- drill, concrete bit, masonry nails or anchors if attachment to concrete is required
- power hand saw and stone blade for cutting stucco if required
- safety equipment such as goggles, gloves and a hard hat should be used when working with power tools

Wall Preparation

Begin by digging a trench around your foundation (Figure 14). Clean the newly exposed wall area of dirt or other debris with a brush or scraper. **If the black waterproofing is dry, cracked or missing, repair the affected area.** Building supply stores carry bituminous (tar) coatings for this purpose that can be brushed on by the homeowner. Be sure to allow any new waterproof coatings to dry completely before applying insulation.

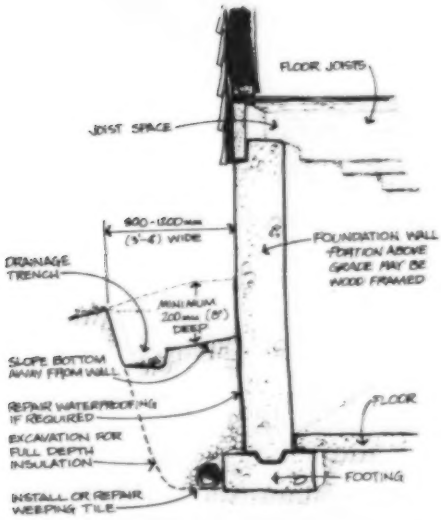


Figure 14

Inspect all wall penetrations and surface-mounted fixtures such as exterior taps, exhaust vents, electrical outlets, hose bibs and gas lines. These should be sealed with a waterproof putty or grout or a silicone sealant. If possible, extend fixtures out from the wall to accommodate the insulation. **Use qualified tradespeople to move gas or electrical fixtures.**

Carefully remove the lower portion of the siding or stucco. The top edges of the outside insulation should be a few centimetres above the line of the subfloor. In this way, both the joist space and the wall below will be completely insulated. It also allows you to caulk around the joist header where it meets the upper and lower floor.

Leave the lower edge of the siding or stucco and building paper pulled away a few millimetres from the wall so that flashing (called drip cap or J-channel) can be installed beneath it. The flashing allows the insulation to extend beyond the line of the siding or stucco without creating a problem and protects the top of the insulation from rain. The flashing should be wide enough to cover both the insulation and protective coating.

Slide the flashing into place under the existing siding or stucco and building paper before the wall insulation is installed. The bottom siding nails may have to be cut off before sliding the flashing in place. After the insulation and protective covering are in place, lower the flashing slightly and attach it with roofing nails to complete the job. The secured flashing thus provides a waterproof cover for the wall insulation and wall joint.

It may not be possible to remove the stucco or siding above the level of the subfloor. In that case, place the outside insulation as high as possible. The remaining uninsulated portion, usually the joist space, can be insulated and sealed on the inside as described previously.

Wall Insulation

Two types of materials are used for insulating outside foundation walls: extruded or expanded polystyrene and rigid glass fibre. Expanded polystyrene, also known as beadboard, is available in different densities. **Type 1 has the lowest density and is not recommended for below grade applications.**

Extruded and expanded (except for Type 1) polystyrene can be used underground for both vertical and horizontal applications. Rigid glass fibre can only be used vertically against the wall.

The method for applying insulation to basement walls depends on the type and thickness of the insulation and the soil conditions. Check with your local distributor or the manufacturer of external insulation for recommended methods. Because of the work involved using this method, you should insulate to a minimum of RSI 1.2 (R 7).

Wall Covering

The insulation must be protected to avoid physical damage from lawnmowers or garden tools. Some rigid insulation materials will deteriorate if not protected from prolonged exposure to sunlight. A number of materials can provide this protective covering: pressure-treated plywood, asbestos cement board, latex-based stucco, cement, brick and treated siding. Use a stucco or siding to match your home.

Stucco can be applied over a wire lath which can be attached directly to the rigid insulation. Some new products do not require use of a wire lath. Stucco can also be applied over plywood sheathing. Wear hand and eye protection when working with wire lath.

Siding materials such as plywood or asbestos cement board can be applied over 38 mm (1½ inches) rigid insulation by using long concrete nails. Using wood strapping at the top and bottom will make this method easier. To attach it over thicker insulation, support framing must be built to provide a nailing surface (Figure 15). You can also use siding or stucco over pressure-treated plywood. The treated plywood should reach below ground level to provide added insulation protection. Pressure-treated plywood can also be painted to provide an inexpensive finish.

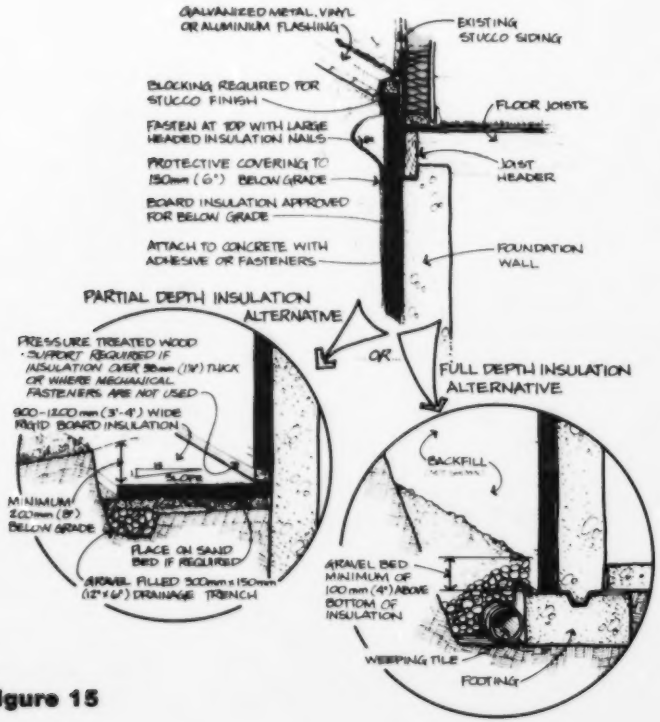

GALVANIZED METAL, VINYL OR ALUMINUM FLASHING
EXISTING STUCCO SIDING
BLOCKING REQUIRED FOR STUCCO FINISH
FLOOR JOISTS
FASTEN AT TOP WITH LARGE HEADED INSULATION NAILS
PROTECTIVE COVERING TO 150mm (6") BELOW GRADE
JOIST HEADER
BOARD INSULATION APPROVED FOR BELOW GRADE
ATTACH TO CONCRETE WITH ADHESIVE OR FASTENERS
FOUNDATION WALL
PARTIAL DEPTH INSULATION ALTERNATIVE
OR
FULL DEPTH INSULATION ALTERNATIVE
PRESSURE TREATED WOOD SUPPORT REQUIRED IF INSULATION OVER 38mm (1½") THICK OR WHERE MECHANICAL FASTENERS ARE NOT USED
900-1200 mm (3'-4') WIDE RIGID BOARD INSULATION
SLOPE
MINIMUM 200mm (8") BELOW GRADE
PLACE ON SAND BED IF REQUIRED
GRAVEL FILLED 300mm x 150mm (12" x 6") DRAINAGE TRENCH
BACKFILL
GRAVEL BED MINIMUM OF 100 mm (4") ABOVE BOTTOM OF INSULATION
WEEPING TILE
FOOTING

Figure 15

Floor Insulation

Although basement floor insulation is hard to justify from an energy savings point of view, unless you have radiant floor heating, it can increase the comfort level considerably. A carpet with thick underlay will provide a minimum level of thermal comfort. A more effective method is to build an insulated subfloor, or sleeper floor.

A word of caution. Ensure that your basement is dry before insulating the floor. Check for moisture by placing a square piece of polyethylene at several locations on the floor. Seal the edges with masking tape. If a damp spot occurs within 24 hours, the floor is too moist. **Avoid insulating the floor in areas where shifting or swelling soils might lift the basement floor.**

First, place a polyethylene moisture barrier on the concrete to prevent the transfer of moisture to the subfloor (Figure 16). Frame and insulate the subfloor with batts or rigid board insulation. Shim the sleepers as required to provide a level surface. Apply an air/vapour barrier, and then install plywood sheeting and floor covering.

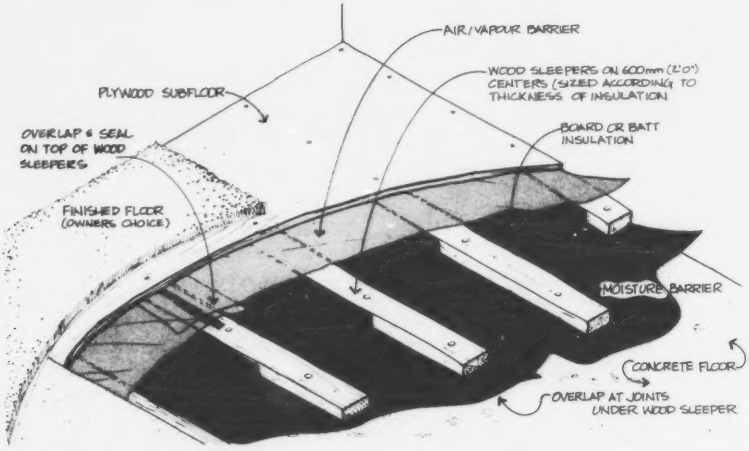

AIR/VAPOUR BARRIER
WOOD SLEEPERS ON 600mm (2'-0") CENTERS (SIZED ACCORDING TO THICKNESS OF INSULATION
PLYWOOD SUBFLOOR
OVERLAP & SEAL ON TOP OF WOOD SLEEPERS
BOARD OR BATT INSULATION
FINISHED FLOOR (OWNERS CHOICE)
MOISTURE BARRIER
CONCRETE FLOOR
OVERLAP AT JOINTS UNDER WOOD SLEEPER

Figure 16

Summary

- Choose between exterior or interior basement insulation.
- Decide on materials to use, including existing materials that can be salvaged, and then measure your requirements and obtain cost estimates from suppliers or contractors.
- Obtain permits for changes in the building and in the electrical system.
- For interior method:
  - seal wall and joist space
  - apply moisture barrier (to grade level only)
  - frame wall and make electrical, plumbing and heating changes required
  - apply insulation to the wall
  - apply air/vapour barrier
  - finish walls, ceilings and window casings
- For exterior method:
  - excavate and clean the wall of dirt and debris
  - remove siding or stucco to level required
  - insulate wall by selected method
  - apply wall insulation protection
  - backfill excavation carefully
  - install siding and flashing protection
- Consider insulating the floor to provide extra comfort.

Now you can sit back and enjoy the benefits of your basement insulation project. You will appreciate the energy and money savings and the increased comfort and living space in your home.

Zenith 22339 (Edmonton 427-5300)

Call this number to reach the "Energy Matters" inquiry service. The hotline expert can provide you with more information on basement insulation and answer your specific questions on this and other energy conservation products and techniques.